Do Entry Barriers Reduce Productivity? Evidence from a Natural Experiment

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1. Introduction

An important means by which market economies restructure and innovate is through the entry and exit of establishments. Given the importance of business turnover for productivity growth, rigid entry barriers tend to protect incumbent firms' interests to the detriment of productivity.

Deregulation of entry has been a core component of recent market reforms in many countries. There are a number of channels through which reductions in entry barriers could influence aggregate productivity. First, theoretical models show that entry barriers generate misallocation by introducing distortions to profitability that inhibit reallocations of market shares across firms and reduce incumbent firms' innovation incentives (Schivardi and Vivano, 2011; Hsieh and Klenow, 2009). Second, the increase in competitive pressure entrants generate leads the least productive firms to exit and reallocates market share. Third, new firms are often the conduits of new technologies, products and processes that advance the technological frontier (Aghion et al., 2009). Finally, the threat of entry may spur incumbents to innovate (Goolsbee and Syverson, 2008).

Establishing the causal effect of entry barriers on productivity poses a tricky identification challenge because entry barriers tend to be correlated with a wider set of government regulations and impediments that also affect productivity (e.g. taxation, monopoly power), or because an appropriate counterfactual does not exist. I circumvent these problems using a natural experiment in the U.S. agricultural sector. This setting allows me to observe an exogenous change in entry barriers and the productivity response within two similar industries. The findings indicate that productivity increases substantially following the removal of entry barriers.

2. Data and Identification Strategy

The data are drawn from the National Agricultural Statistics Service (NASS). The NASS is the statistics branch of the U.S. Department for Agriculture and conducts hundreds of surveys each year on issues relating to agricultural production, demographics and the environment. As part of this mission the NASS administers an annual survey of crop yields, output, and acreage in each county. As in Butler and Cornaggia (2011), I proxy productivity using crop yield (tons produced per acre). I therefore have annual information on productivity and acres planted for several industries (sugar beet, corn, wheat, and barley) in each U.S. county over the period 1965 to 1985. Information on the price received for each crop is also available from the NASS, albeit at the state level. A summary of the data is reported in Table 1.

[INSERT TABLE 1]

2.1 Institutional Detail

The U.S. sugar manufacturing cartel was established under the New Deal in the Jones-Costigan Act of 1934 to limit sugar sales and restrict foreign sugar imports. Under the cartel plan, entry of firms into the sugar beet industry was prohibited. Existing sugar beet farmers were assigned an acreage quota based on pre-cartel planted acres that they could not exceed. Although it was illegal to sell the quota, it could be inherited by family members (Bridgman et al., 2009). Following an unexpected surge in world sugar consumption, sugar prices markedly increased during 1974 and political support for the cartel evaporated. The Act was not renewed and the cartel and its provisions ceased in 1975, permitting free entry into sugar beet farming (Corley, 1975). Whereas entry into the sugar beet industry was prohibited until 1975, free entry into corn farming was permitted during the entire sample period.

2.2 Identification Strategy

The sharp asymmetry in treatment status between corn (the control group) and sugar beet (the treatment group), together with the plausibly exogenous collapse of the sugar cartel forms the backbone of my quasi-experiment. I pin down the causal effect of entry barriers on productivity using a difference-in-difference estimation strategy that estimates the equation

$$yield_{ict} = \alpha + \beta_1 Sugar\ beet_{ict} + \beta_2 Treatment_t + \beta_3 (Sugar\ beet * Treatment)_{ict} + \delta X_{ict} + \gamma_c + \gamma_t + \varepsilon_{ict}\ , \qquad (1)$$

where $yield_{ict}$ is yield per acre in industry i of county c at time t; $Sugar\ beet_{ict}$ is a dummy equal to 1 if the observation is from the sugar beet industry, 0 for corn; $Treatment_t$ is equal to 1 for the years 1975 onwards, 0 otherwise; X_{ict} is a vector of controls comprising acres planted; γ_c and γ_t are county and year dummies respectively; ε_{ict} is the error term. Standard errors are clustered at the state-industry level.

[INSERT FIGURE 1]

Figure 1 provides graphical evidence on the key identifying assumption of parallel trends. Given the high degree of co-movement between pre-treatment productivity in the two sectors, the fact that corn and sugar beet are grown in the same geographic areas, planted in spring and harvested in fall, the similarities between production practices in the two industries (tractors, ploughs and seeders are used during planting while combines are used during harvesting), and that corn and sugar beet are not grown in rotation, corn appears to be a valid counterfactual.

3. Results

[INSERT TABLE 2]

I begin by reporting descriptive evidence. Figure 1 shows a clear jump in sugar beet productivity in the aftermath of the sugar cartel's failure that is not mirrored by corn productivity. This observation is supported by the formal estimation results in Table 2. In column 1 of Table 2 the average treatment effect on the treated (ATT) is estimated to be 3.64 tons per acre. This effect is both economically and statistically significant, equating to a 24% increase on pre-treatment average industry productivity. The sugar beet dummy coefficient indicates that a planted acre produces approximately 12 tons more sugar beet than corn, while the coefficient on the treatment dummy shows that yield per acre increased by only a modest amount within the control group post 1974. In addition, the acres planted variable is insignificant suggesting an absence of economies of scale.[1]

An important question is to what extent input usage changed over the time period. While county-level data are not available, historic versions of the U.S. Agricultural Census and industry-level data

[1] The results are robust to trimming the sample to the years 1970 to 1980.

reported by USDC (1975) indicate that input expenditure in the corn and sugar beet industries remained broadly unchanged across the sample window. The previous findings therefore indicate improvements to technical efficiency.

3.1 Robustness Testing

Before concluding that entry barriers reduce productivity causally, I need to rule out potential confounding influences. In this setting the main concern regarding omitted variables is that the removal of entry barriers coincides with unknown contemporaneous improvements in the local business environment. To rule out this possibility I exploit the panel structure of the data to purge omitted variable bias. The results reported in column 2 are estimated conditional on county-year fixed effects that eliminate the confounding influence of time-varying, county-specific productivity factors common to both industries. An attractive property of this specification is that the treatment effect is estimated through between-industry variation within the county-year dimension of the data which provides exceptionally clean identification. The effect is now found to be 4.60 tons per acre. Next, in column 3 I flood the model with county-year, county-industry and industry-year fixed effects to remove additional omitted variables. This has very little impact on the main findings. I continue to find the eradication of entry barriers to significantly increase productivity. The estimate is now equivalent to a 35% productivity gain relative to pre-treatment levels.

Given that the results in column 3 are estimated conditional on a battery of fixed effects, the only plausible remaining source of bias is through contamination of the implied counterfactual which may occur if there were spillover effects on the control group. I address this issue from two angles. First, I re-estimate equation (1) using alternative control groups. Despite this change, I continue to find ATTs of similar magnitude and statistical significance when I use wheat (column 4) and barley (column 5) as the control group. Second, I run Monte Carlo simulations to check that productivity in the corn sector was unaffected by treatment. I conduct this test by using only data from the corn industry. I then randomly assign counties to 'treatment' status and set the placebo treatment dummy equal to 1 for the years 1975 to 1985 for the 'treated', and 0 otherwise. Next, I estimate the equation

$$yield_{ict} = \alpha + \beta Placebo_{ict} + \delta X_{ict} + \gamma_c + \gamma_t + \varepsilon_{ict} \,. \quad (2)$$

I repeat this procedure 1,000 times and save the p-value of the β coefficient each time. The intuition underlying this test is that if spillover effects were present, I would disproportionately reject the (true) null hypothesis of $\beta = 0$. If spillover effects are not present the null hypothesis should only be rejected by chance (type-1 errors). The rejection rates at the 10%, 5%, and 1% significance levels are 4%, 1.1% and 0% respectively indicating the control group was unaffected by the treatment.[2]

The downwards trend in sugar beet productivity during the years immediately preceding treatment raises the question of whether the results are driven by Ashenfelter's dip. This is unlikely given the evolution of productivity is very similar within the control group. To rule out this possibility

[2] I use the same procedure but using corn acres planted as the dependent variable to check whether acres were reallocated to the control group. The rejection rates are in line with type-1 errors indicating that no reallocation of acres took place (9.6%[10% level], 5.4%[5% level], 0.9%[1% level]).

I collapse the variables on their pre- and post-treatment means for each county-industry and re-estimate equation (1) using the new data. The results in Table 2 column 6 are robust to this change.

[INSERT FIGURE 2]

Could the treatment effect stem from a fixed number of incumbent producers shifting from collusive to non-collusive market behavior without actually being threatened by entrants post 1975? The data in Figure 2 indicate sustained reductions in the number of sugar beet farms post treatment which suggest that this was not the case.

Finally, in column 7 I find the treatment caused a 29% increase in revenue per acre (measured as ln(yield * deflated prices)).

4. Conclusions

In this paper, I show using a natural experiment that eliminating barriers to entry cause significant productivity improvements. This is consistent with the view that entry barriers inhibit creative destruction and create inefficiencies by reducing competition for market share which decreases innovation incentives and reallocation among incumbents. While I establish the net effect of entry barriers on productivity, future work should seek to establish the specific channels through which this is manifested.

References

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Tables

Table 1
Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max	Level of Aggregation
Sugar beet	2,746	0.31	0.47	0	1	County-industry
Yield	2,746	7.65	8.48	0.25	39.50	County-industry
Acres planted (ln)	2,746	8.05	5.40	-13.82	12.40	County-industry
Price ($)	2,746	11.91	15.08	0.97	51.40	State-industry
Revenue (ln)	2,746	2.98	2.40	-1.12	7.43	County-industry

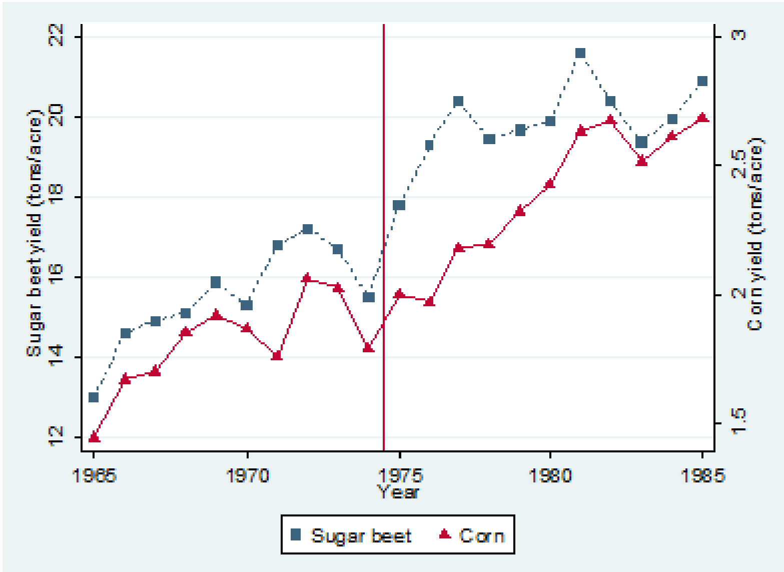
Table 2
Productivity Results

Regression no.	1	2	3	4	5	6	7
Control group		Corn		Wheat	Barley	Corn	Corn
Sugar beet	12.9740***	12.9237***	12.4947***	11.7957***	17.3483***	10.3297***	4.7168***
	(24.50)	(97.69)	(20.28)	(4.21)	(917.02)	(8.13)	(48.65)
Treatment	0.8082						
	(1.35)						
Sugar beet * Treatment	4.5351***	5.2974***	4.7509***	2.9072***	2.9296***	9.7633***	0.2555**
	(4.89)	(3.62)	(5.62)	(14.62)	(148.37)	(5.19)	(2.23)
Acres planted	-0.0008	0.4780	-0.1930	-0.2796	-0.0000**	0.0653	0.0064
	(-0.03)	(1.40)	(-0.38)	(-0.47)	(-2.54)	(1.06)	(0.10)
Observations	2,746	2,746	2,746	2,597	2,554	265	2,746
R^2	0.95	0.97	0.99	0.99	0.99	0.98	0.99
County effects	√					√	
Year effects	√						
Period effects						√	
County-year effects		√	√	√	√		√
County-industry effects			√	√	√		√
Industry-year effects			√	√	√		√

Notes: The standard errors are clustered at the state-industry level and the associated t-statistics are reported in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels.

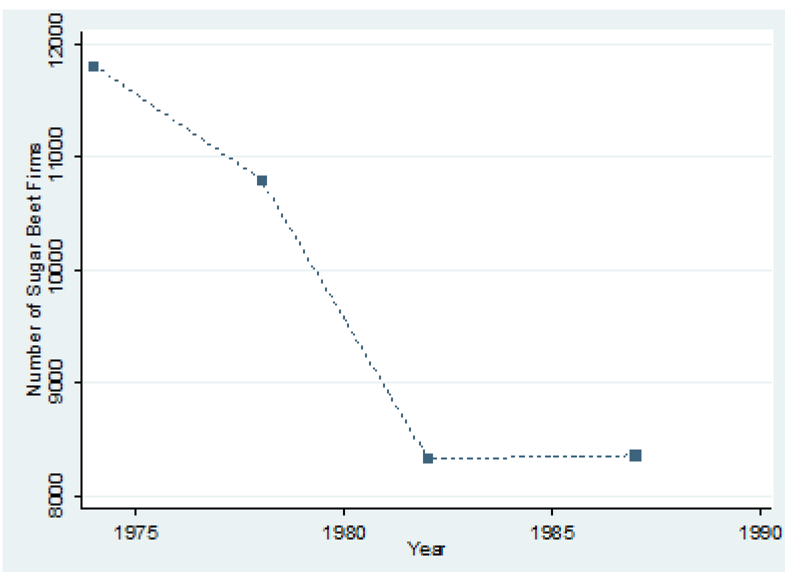
Figures

Figure 1
Productivity Evolution



Notes: This figure plots mean yield for each industry-year during the sample period.

Figure 2
Number of Producers



Notes: This figure plots the number of sugar beet farms operating in the U.S. reported in the Census of Agriculture. Data are not available for the years preceding 1974.